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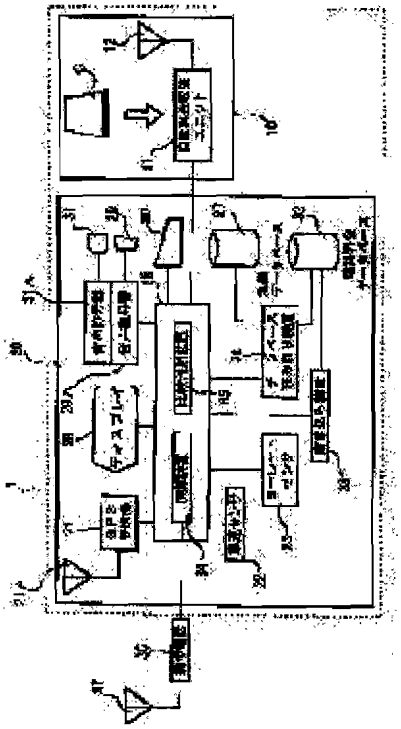
(54) TOLL SHORTAGE WARNING DEVICE IN ELECTRONIC TOLL COLLECTION SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To make it possible to immediately cope with the shortage of a balance in an IC card at the time of paying a toll in an electronic toll collection(ETC) system.
SOLUTION: A car navigation device 20 storing map data and toll data for toll roads and capable of recognizing the current position information of an automobile has a map data base 27 and a toll data base 32 and can recognize the current position of the automobile by a GPS receiver 21 or the like. An arithmetic unit 34 calculates the utilization charge of a toll road in the driving of the automobile. A comparing/judging device 35 compares the utilization charge with the balance of an IC card to judge whether the balance is in short or not. In the case of a short balance, a user is warned through a speaker 29 or the like before arrival at an interchange generating the shortage of the balance.



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CLAIMS

[Claim(s)]
[Claim 1] By the bidirectional radio of the equipment on the street installed in the road and the mounted equipment installed in the automobile In the mounted equipment in the electronic toll collection system which has an IC card electronically and performs tariff **** processing in a commercial transaction, while memorizing map data and the account data of a turnpike The navigation equipment which recognizes the currency information of an automobile, and said map data, An operation means to compute the use tariff of the turnpike which said automobile is running based on the inlet-port information at the time of the account data of said turnpike and said automobile going into a turnpike, and the currency information of said automobile, A comparative judgment means to judge whether said use tariff computed by this operation means is compared with the frame [payment / a frame] of said IC card, and said use tariff becomes insufficient funds over the frame [payment / a frame] of said IC card, The tariff insufficient warning device in the electronic toll collection system characterized by having a warning means to warn before the accounting location used as insufficient funds when it judges that said comparative judgment means becomes insufficient funds.
[Claim 2] The tariff insufficient warning device in the electronic toll collection system according to claim 1 characterized by having write-in equipment which writes the amendment information transmitted from said equipment on the street when the tariff of said turnpike is reformed in the account data of said turnpike which said navigation equipment has memorized.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the mounted equipment in an electronic toll collection system, especially, is equipped with navigation equipment and relates to the tariff insufficient warning device in the electronic toll collection system which warns in case the tariffs for an electronic fee collection sytem are insufficient.
[0002]
[Description of the Prior Art] In turnpikes, such as a highway, in order to pay a tariff, an automobile must stop in a tollgate and the stop of this automobile has become the big factor of delay. While easing such delay, construction of the electronic toll collection system (it is called an "ETC system" Electric Toll Collection and the following.) which can perform payment of a tariff, without an automobile stopping in a tollgate in recent years for the purpose of the full automation in a tollgate and cashless-payment-izing is advancing.
[0003] As shown in drawing 3 , the ETC system 100 is equipped with equipment 110 on the street and mounted equipment 120. Equipment 110 on the street is equipped with the communication link processor 112 on the street while it has the antenna 111 on the street. Moreover, this communication link processor 112 on the street is equipped with a communication device, a tariff processor, type-of-a-car distinction equipment, etc. As an antenna 111 on the street, preliminary announcement antenna 111A and inlet-port antenna 111B are prepared in the inlet port of a turnpike, accounting antenna 111C and tollgate antenna 111D are prepared in the outlet, and bidirectional radio with Automobile M is made possible with these antennas 111 on the street. Moreover, in order to use for distinction of a type of a car etc., the camera equipment 113 which photos the automobile M it is running is formed.
[0004] On the other hand in mounted equipment 120, IC card 121 which attests a user is inserted, and while the IC card reader 122 which write the information on IC card 121 concerned is formed, the monitor 123 and loudspeaker 124 which notify various information are prepared. Furthermore, the mounted antenna 125 which receives the various information which transmits the information acquired from IC card 121 grade to the antenna 111 on the street, and is transmitted from the antenna 111 on the street is formed. In addition, the main control section for carrying out generalization control of the mounted equipment 120 etc. is prepared in mounted equipment 120.
[0005] And as the continuous line of drawing 3 shows, when the automobile M equipped with the above-mentioned mounted equipment 120 uses a turnpike, various information, such as inlet-port information that detected Automobile M and it went into the justification of IC card 121 and a turnpike with the equipment 110 on the street which has preliminary announcement antenna 111A installed in the inlet port of a turnpike, inlet-port antenna 111B, camera equipment 113, etc., such as a location and time amount, type-of-a-car information, and a hour entry, is detected. The propriety of whether to be able to pass without Automobile M stopping by this is judged. Then, in case Automobile M starts from a turnpike, the accounting information by which the automobile M shown by the imaginary line of drawing 3 is obtained from type-of-a-car information and inlet-port information by accounting antenna 111C is detected, and accounting (electronic fee collection sytem) is made. And the propriety of whether to be able to pass without accounting information's being detected by tollgate antenna 111D, and as a result stopping by it is judged. And by the tariff processor and type-of-a-car distinction equipment in equipment 110 on the street, type-of-a-car distinction and tariff processing are performed, and tariff information is transmitted to the central-process center 130. In addition,

/hen performing tariff **** at the inlet port of a turnpike, accounting antenna 111C will be prepared in an inlet port, and accounting (electronic fee collection sytem) will be made at an inlet port.
[0006] On the other hand, in the central-process center 130, when IC card 121 is a postPEIDO (credit) type card, based on the received tariff processing information, a tariff is charged directly ex post and processing paid to a tariff collection person is performed from a user's bank account registered into IC card 121 concerned of the tie-up financial institution 140. Moreover, when IC card 121 is a prepaid type, it has the composition of rewriting electronically from the balance of the amount of money electronically memorized to IC card 121 concerned, and paying the tariff of a turnpike to a tariff collection person on that spot.
[0007]
[Problem(s) to be Solved by the Invention] By the way, with the prepaid card of them, although there are a prepaid card and a postPEIDO card, since there is a limit in the balance, when the use tariff of a turnpike serves as insufficient funds exceeding the balance, if the IC card used by the ETC system remains as it is, an ETC system cannot be used for it. Therefore, in order to pay the tariff of a turnpike using an ETC system, it needed to come out at the interchange before becoming insufficient funds, or increase of a product needed to be performed in the intermediate service area (or it is the same as that of a parking area and the following).
[0008] However, in the conventional ETC system, it was not able to judge immediately whether it would become insufficient funds. Therefore, a user may notice them being insufficient funds just before the interchange out of which it is going to come, and, in such a case, the intention of using an IC card must pay a use tariff with cash, a Highway Card, etc. Therefore, since a user would prepare cash and a Highway Card confusedly, danger, such as mind being taken by preparing cash etc. and leading to accident, increases and was inconvenient [the user]. Moreover, since it was obliged to course modification to the correspondence gates, such as cash, in spite of having passed through the gate only for ETC systems and having had, it was that whose part risk of the increases.
[0009] Furthermore, even if an IC card is a postPEIDO card, when the upper limit is set as the amount of money which can be paid, for example with a postPEIDO card, the same problem as the case where an IC card is a prepaid card arises.
[0010] Then, when it is going to pay the use tariff of a turnpike using an ETC system, the technical problem of this invention is to offer the tariff insufficient warning device which warns that suitable correspondence can be taken immediately, even if it is the case where the balance of an IC card runs short.
[0011]
[Means for Solving the Problem] The tariff insufficient warning device in the mounted tariff **** system concerning this invention which solved the above-mentioned technical problem By the bidirectional radio of the system on the street installed in the road and the mounted system installed in the automobile In the mounted equipment in the electronic toll collection system which has an IC card electronically and performs tariff **** processing in a commercial transaction, while memorizing map data and the account data of a turnpike The navigation equipment which recognizes the currency information of an automobile, and said map data, An operation means to compute the use tariff of the turnpike which said automobile is running based on the inlet-port information at the time of the account data of said turnpike and said automobile going into a turnpike, and the currency information of said automobile, A comparative judgment means to judge whether said use tariff computed by this operation means is compared with the frame [payment / a frame] of said IC card, and said use tariff becomes insufficient funds over the frame [payment / a frame] of said IC card, When it judges that said comparative judgment means becomes insufficient funds, it is characterized by having a warning means to warn before the accounting location used as insufficient funds.
[0012] In this invention, the use tariff at the time of an automobile running a turnpike is computed using navigation equipment. And when becoming insufficient funds at this rate about that use tariff as compared with the frame [payment / a frame] of an IC card, before becoming insufficient funds, the suitable correspondence for crew can be urged by telling crew about that fact. Therefore, a user can do increase of a product, without being panicked, or can prepare cash and a Highway Card and can finish payment of the use tariff of a turnpike.
[0013] moreover, invention concerning claim 2 — the configuration of claim 1 — in addition, it is characterized by having write-in equipment which writes the amendment information transmitted from

said system on the street when the tariff of said turnpike is reformed in the account data of saic turnpike which said navigation equipment has memorized.
[0014] The tariff of a turnpike is suitably reformed according to a social situation etc. A positive comparison cannot be carried out when mounted equipment does not recognize this reformed tarif By this point and this invention, since a mounted system can acquire the amendment information on a turnpike, the use tariff of a turnpike can be certainly compared with the balance of an IC card.
[0015]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained concretely, referring to a drawing. Drawing 1 is the system block Fig. of mounted equipment equipped with the tariff warning device concerning this invention. Mounted equipment 1 is equipped with the main frame 10 and the navigation equipment 20 used as the tariff insufficient warning device concerning this invention.
[0016] The main frame 10 has the electronic fee collection sytem antenna 12 with the electronic fee collection sytem unit 11, and the communication device for performing IC card reader which write data to IC card C, equipment on the street, and bidirectional radio etc. is formed in the electronic fee collection sytem unit 11. And from the electronic fee collection sytem unit 11, accounting information etc. is transmitted to the navigation ECU 25 in navigation equipment 20 mentioned later.
[0017] In an automobile equipped with this main frame 10, after inserting in IC card reader which does not illustrate IC card C, it attests by inputting a personal identification number, a keyword, etc. which were inputted by the control unit 30 in navigation equipment 20 mentioned later. The unauthorized use of IC card C by so-called "spoofing" which becomes an unauthorized use person and is cleared up according to this authentication is eliminated. Moreover, although these personal identification numbers etc. are used, the thing using the bodily features of others and a user, for example, a fingerprint, a voiceprint, and iris freckles etc. is considered. This authentication is performed when IC card C is usually inserted in IC card reader.
[0018] Moreover, tariff **** processing of a turnpike is performed through the electronic fee collection sytem antenna 12, with the electronic fee collection sytem antenna 12, the antenna 111 on the street and bidirectional radio which are shown in drawing 3 are performed, and accounting information is received. This accounting information is displayed on the display 28 in navigation equipment 20 mentioned later. Furthermore, when automatic payment of the use tariff of a turnpike is performed, it is transmitted to the antenna 111 on the street shown in drawing 3 through the tariff **** antenna 12, and information offer to the tie-up financial institution 140 is performed. Furthermore, it is written in IC card C by IC card reader, and accounting is performed by the result.
[0019] Navigation equipment 20 is the so-called hybrid type, and is equipped with GPS receiver 21, a speed sensor 22, the yaw rate sensor 23, the database reader 24, and the navigation ECU 25 that carries out generalization control of these. In GPS receiver 21, the electric wave transmitted from the GPS Satellite which is not illustrated is received by GPS antenna 21A, and it transmits to navigation ECU 25. And the absolute location of an automobile is computed in navigation ECU 25.
[0020] Moreover, the rate data of an automobile are detected in a speed sensor 22, and the bearing data of an automobile are detected in the yaw rate sensor 23. Then, rate data and bearing data, and the map data read in the map database 27 with the database reader 24 are mapped in navigation ECU 25, and the relative position of an automobile is computed.
[0021] The location of an automobile is judged in navigation ECU 25, taking suitably such absolute positional information and relative-position information into consideration. And the result was suitably displayed on the display 28, or the loudspeaker 29 has notified through voice decoder 29A as speech information. In addition, a control unit 30 can perform various kinds of actuation, such as actuation of turning on navigation equipment 20, and actuation of changing the display screen of a display 28.
[0022] Moreover, speech information can be inputted with the microphone 31 connected to navigation ECU 25 through voice coder 31A. Furthermore, it has the road tariff database 32, the use tariff of various turnpikes is memorized, and navigation equipment 20 can read the account data of a turnpike with the database reader 24. Moreover, when the account data memorized by the road tariff database 32 is reformed, the account data after amendment can be written in with write-in equipment 33.
[0023] Furthermore, an arithmetic unit 34 and comparative judgment equipment 35 are formed in navigation ECU 25. The use tariff of the turnpike which an automobile is running is computed based on the currency information of the automobile obtained from the map data with which an arithmetic unit

34 is obtained from the map database 27, the account data obtained from the road tariff database 32, GPS receiver 21, etc. Moreover, comparative judgment equipment 35 compares the frame [payment / a frame] of this use tariff and IC card C, and a judgment whether a use tariff becomes insufficient funds over the frame [payment / a frame] is made. In addition, the cellular phone 36 is connected to navigation ECU 25, and the information in navigation ECU 25 can be suitably transmitted now to other automobiles etc. Moreover, a sign 37 is a cellular-phone communications aerial.

[0024] Now, in the mounted equipment 1 concerning this invention, when comparing the use tariff of the turnpike which an automobile is running with the frame [payment / a frame] of IC card C and becoming insufficient funds, it has the function to warn before the accounting location. Hereafter, the control at that time is explained taking the case of the case where it runs the turnpike shown in drawing 2 .

[0025] In addition, in this example, when going into interchange X1, the tariff information which it will not be set to IC card C inserted in the mounted system 1 in Automobile M with insufficient funds if it is a use tariff to interchange X3, but will serve as insufficient funds if it runs to interchange X4 will be memorized. Moreover, interchange X2, X3, and X4 becomes an accounting location.

[0026] Now, the automobile M carrying mounted equipment 1 goes into Turnpike R from interchange X1. From the communication link processor 112 (refer to drawing 3) on the street installed in interchange X1, the automobile M included in Turnpike R receives inlet-port information through the electronic fee collection sytem antenna 12. It is transmitted to the electronic fee collection sytem unit 11, and this inlet-port information is used in order to compute the next amount of accounting. Furthermore, this inlet-port information is transmitted to the navigation ECU 25 in navigation equipment 20. Moreover, the current position of Automobile M is always recognized by the currency information of the automobile obtained from GPS receiver 21 etc. In navigation ECU 25, the use tariff paid with an arithmetic unit 34 at interchange is computed with the map data read with the inlet-port information, the currency information, and the database reader 24 of these automobiles M, and road account data.

[0027] In the automobile M1 which is running the root R1 between interchange X1 and interchange X2, when coming out in either of the interchange X2 and X3, it judges whether it becomes insufficient funds. This judgment is made by comparing the balance of IC card C obtained from the use tariff and the electronic fee collection sytem unit 11 to the interchange X2 and X3 computed by the arithmetic unit 34. That is, when the use tariff of interchange X2 and X3 exceeds the balance of IC card C, it is judged that a tariff is insufficient. A judgment whether future tariffs are insufficient is made similarly.

[0028] Now, in this example, IC card C is loaded with the frame [payment / a frame] used as insufficient funds in transit to interchange X2 and X3. Therefore, if this judgment is made, since it will not be judged as insufficient funds in the automobile M which runs the root R1, payment of the tariff by the ETC system is possible. Therefore, warning etc. is not performed.

[0029] In the automobile M2 which passes through interchange X2 and runs the root R2 soon, if it is to interchange X3, it does not become insufficient funds, but since the use tariff to interchange X4 exceeds the balance of IC card C, it is judged to be insufficient funds. Therefore, in the automobile M2 which runs the root R2, warning of the purport "it will become insufficient funds if it passes through the next interchange" is performed. This warning may be based on voice and may carry out image display. When warning with voice, a loudspeaker 29 is used, and a display 28 is used when carrying out image display. A user can choose whether it comes out at interchange X3, or it passes through interchange X3 and transit of Turnpike R is continued further based on this warning.

[0030] When coming out at interchange X3, the use tariff of a turnpike can be paid by IC card C as it is. On the contrary, for insufficient funds, if the automobile M3 which does not perform selection which comes out at interchange X3, but is continuing transit to the root R3 remains as it is, it cannot perform payment of the use tariff of the turnpike by the ETC system. Then, to the automobile M3 which runs the root R3, increase of a product of a tariff is made in a "order service area. Unless it carries out increase of a product, automatic payment cannot be carried out at the next interchange. It warns of the purport ". The product increase equipment (not shown) of IC card C is installed in service area SA/PA. Therefore, the user who wants to carry out increase of a product can make selection of stopping at following service area SA/PA, and can do increase of a product by the service area SA/PA.

[0031] If product increase of amount of money sufficient by service area SA/PA is carried out, the

automobile M4 which runs the root R4 Since it is in the condition that payment of the use tariff by IC card C can be performed at interchange X4 Warning is not performed (however, it will become insufficient funds, if it passes through "order interchange when product increase only of the amount of money which serves as insufficient funds at the next interchange X5 which is not illustrated is carried out.). warning of the purport " is performed. .
[0032] Payment [the automobile M4 which does not perform increase of a product by service area SA/PA, or runs the root R4 on the other hand when the product increase amount of money is not enough / in interchange X4 / the tariff by the ETC system]. Therefore, automatic payment of a tariff cannot be performed at "order interchange. In coming out at the next interchange, please prepare cash or a Highway Card. Warning of the purport " is performed. By this warning, a user can choose whether a tariff is paid with cash or a Highway Card, or product increase of the tariff is carried out in a subsequent service area (parking area), without coming out at interchange X4 at interchange X4. Moreover, selection of paying a tariff with cash or a Highway Card at next interchange can also be made.
[0033] Henceforth, whenever it passes through interchange, the above-mentioned activity is repeated.

[0034] On the other hand, the use tariff of a turnpike is suitably reformed according to a social situation etc. If the account data memorized by the road tariff database 32 is not reformed in spite of having reformed the use tariff of a turnpike, when unnecessary, warning is emitted or it is assumed that the situations — warning is not carried [which it is the need] out to reverse by the way — occur. Then, in this invention, when the use tariff of a turnpike is reformed, the account data after amendment (henceforth "amendment account data") can be written in the road tariff database 32 with write-in equipment 33.
[0035] The writing of amendment account data is performed as follows. It is transmitted from the communication link processor 112 (refer to drawing 3) on the street in a turnpike, and amendment account data receives this with the electronic fee collection sytem antenna 12, and is transmitted to navigation ECU 25 through the electronic fee collection sytem unit 11. From navigation ECU 25, amendment account data is written in, it can transmit to equipment 33 and amendment account data can be written in the road tariff database 32 with write-in equipment 33. Therefore, the automobile M which runs a turnpike can perform processing which performs the above-mentioned warning based on amendment account data. In addition, when the use tariff of a turnpike is reformed, that is told to Automobile M using an ETC system, a screen display can be carried out to a display 28, or a loudspeaker 29 can also show a turnpike inlet port to it a voice table.
[0036] As mentioned above, it is possible to change this invention suitably in the range which has the effectiveness which is not limited to the means and technique which were not necessarily described above, attains the purpose said to this invention, and is said to this invention, although the suitable operation gestalt of this invention was explained, and to carry out. For example, write-in equipment 33 cannot be formed but can also be made into the mode corresponding to tariff amendment of a turnpike by exchanging road tariff database 32 the very thing.
[0037] On the other hand, if amendment account data comes to be offered by vehicle information communication system like VICS expected to develop in the future, the VICS receiver which does not illustrate the amendment account data from an telecommunications system can receive, and measures, such as writing in the road tariff database 32, can also be taken.
[0038]
[Effect of the Invention] According to this invention the above passage, when it is going to pay the use tariff of a turnpike using an ETC system, even if it is the case where the balance of an IC card runs short, suitable correspondence can be taken immediately. Therefore, a user does increase of a product, without being panicked, or becomes possible [preparing cash and a Highway Card and finishing payment of the use tariff of a turnpike].

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of mounted equipment equipped with the tariff insufficient warning device concerning this invention.
[Drawing 2] It is the conceptual diagram showing an example of the transit way at the time of an automobile running a turnpike.
[Drawing 3] It is the conceptual diagram of an ETC system.
[Description of Notations]
1 Mounted Equipment
10 Main Frame
11 Electronic Fee Collection Sytem Unit
12 Electronic Fee Collection Sytem Antenna
20 Navigation Equipment
21 GPS Receiver
21A GPS antenna
22 Speed Sensor
23 Yaw Rate Sensor
24 Database Reader
25 Navigation ECU
27 Map Database
28 Display
29 Loudspeaker
30 Control Unit
31 Microphone
32 Road Tariff Database
33 Write-in Equipment
34 Arithmetic Unit
35 Comparative Judgment Equipment
C IC card
M Automobile
R Turnpike
X1-X4 Interchange

[Translation done.]